RKF Engineering Solutions, LLC
1229 19th St. NW, Washington, DC 20036
Phone 202.463.1567 Fax 202.463.0344

In the Matter of Progeny LMS, LLC

Petition for Waiver of the Rules And Request for Expedited Treatment

WT Docket No. 11-49

COMMENTS OF RKF ENGINEERING SOLUTIONS, LLC

December 21, 2012

Articles lauding the benefits of unlicensed spectrum abound. What was once thought to be junk spectrum is now recognized to be the most economically productive spectrum throughout the world, supporting a diverse range of applications and industries. WiFi networks in homes, businesses and WiFi access points easily dwarf data usage carried on cellular networks. In addition, unlicensed bands are being successfully used to support critical infrastructure, such as home alarm systems, health care monitoring, RFID, SCADA, automated meter reading and wireless internet, and new M2M applications.

Without the burden of costly and bureaucratic spectrum licenses, businesses have been able to innovate freely. Low power transmitter limits and a loose regulatory framework in the band put everyone on an equal footing so that one application can't dominate any other. To maintain this equal footing the FCC has an active enforcement activity for Part 15 devices. It is in the public interest not to stifle innovation in these bands by licensing applications that require disproportionate capacity at the detriment of all other users of the band.

Unlike a Part 15 device deployment, the Progeny system operates in a cellular arrangement using high power base stations(beacons) and with relatively high duty cycle transmissions. The mobile terminals (MT) are intended to operate indoors and out and the cellular design ensures that threebase stations are received over the coverage region to provide a good location fix. This means that the mature solution will probably include a variety of cell sizes (macro, micro, pico, and femto) to ensure complete coverage and to overcome interference from Part 15 devices. This dense deployment will result in interference to Part 15 devices. Instead of working synergistically with the Part 15 devices, the Progeny system will tend to push these devices to other parts of the band or out of the band. In addition, if the FCC opens use of this band to the Progeny system it creates a precedent that will be hard to curtail. Other operators or similar types of applications will also want access to the unlicensed bands.

The rest of this document explains that Progeny has not done sufficient testing or sufficiently documented test results to show that Part 15 devices won't receive harmful interference. Test results and descriptions are primarily pulled from the original Progeny test report.Additionally, tests performed by Itron and WISPA indicate that the Progeny system will cause a significant amount of interference to Part 15 devices in general, even in common consumer configurations. The amount of interference and the effect on most Part 15 devices is significant enough that it could alter the experience for the customers.

Absent from the testing was any mention of overload. It is clear that in areas around the high power Progeny base stations that many Part 15 devices will be susceptible to overload. The overloaded devices will not be able to operate in a large portion of the 900 MHz band. Overload mitigationlikely involves RF filters incorporated into the Part 15 devices. However, this mitigation is not practical because it requires a significant guard band between Part 15 device and the Progeny operating frequency. As such, this situation would be unacceptable to many Part 15 device manufacturers who are losing a large part of the 902-928 MHz band.

Progeny should not be allowed to deploy their system. Their tests have not proven that they won't cause harmful interference. On the contrary there is sufficient evidence that harmful interference tomany Part 15 devices will occur, and that this harmful interferencecan curtail current uses in the band as well as future innovation.

Progeny Test Report – Based on 27 January, 2012 report

In this section we describe the deficiencies in the Progeny test report.

1. **Insufficient number of tested devices.** Specifically, according to the Progeny testing report dated 27 January, 2012, Progeny pulled the FCC Equipment Authorization Database to determine which devices could receive interference from the Progeny system and found that there were 5216 devices that operated in the 902-928 MHz band. However, they then reduced the set to only those approved since January, 2005, giving them a total of 867 – just 16.6% of the possible devices. The set of test devices was further reduced to just 20 devices, which is approximately 0.4% of the devices approved to operate in the 902-928 MHz band. The reduction to only devices approved since January, 2005 is not justified. It is unreasonable to assume that all Part 15 devices tolerate interference in the same way. Testing only 0.4% of the devices approved to operate in the 902-928 MHz band is insufficient to validate that the Progeny system will not cause unacceptable interference levels to the remaining 99.6% of the Part 15 devices.

   Moreover, the random selection of 20 devices is not mentioned again in the Progeny test report and it is unclear how the devices actually tested were selected. The Progeny report mentions a 'non-random' group containing 15 devices, but it is not clear how this group of 15 devices relates to the 17 devices actually tested. It is also unclear whether Progeny attempted to ensure that the 'non-random' group was an impartial and representative sample of the 5216 devices that they could interfere with.

   As such, the lack of detail in the test report and the small number of tested devices makes it impossible to determine whether the test results apply to the Part 15 device environment in general.

2. **Overly General Assumptions**. The Progeny test report made numerous assumptions about Part 15 deployments that are not justified within the report, nor do they necessarily match true Part 15 system deployments. For example, the test report has assumed that Part 15 devices would be on ground level and indoors. This is generally true of many of the devices tested by Progeny, which include baby monitors, wireless speakers, cordless phones and other "Class B" digital devices, but is not true of all Part 15 devices operating in the 902-928 MHz band. Part 15 devices which are located out of doors or above ground-level have the potential to face additional interference due to direct, line-of-sight to the Progeny beacon without being attenuated by building penetration. Of the ten test locations described in Table 8 of the Progeny test report, none of the tests were performed out-of-doors in an open environment and none of the test locations had direct line-of-sight to the nearest beacon.
3. **No Exterior or Line Of Sight Testing.** None of the tests performed by Progeny with consumer devices evaluated the case where the device was operated outside of the building or with line-of-sight to the nearest beacon. This scenario will result in significantly higher interference from the Progeny system than the cases tested.
4. **Poor Commercial Device Testing**. Progeny tested only four commercial devices with the Progeny system. Testing only four devices is not sufficient to demonstrate that similar devices will behave in the same way. In particular, the four devices belong to three different types of Part 15 devices operating in the 902-928 MHz band (an AMR device, a remote control, and an RFID reader). Testing three types of devices with four examples is not sufficient to demonstrate that the results generalize.

In addition to lacking test results with more devices, the test methodology is poorly explained and impossible to generalize. The Progeny test report omits several key details in the test procedure for the commercial devices, such as whether the testing was performed out of doors (as would be typical for the operation of, for example, the AMR device) and how many interior walls were between the transmitter and the receiver. The test procedure mentions that the testing was performed along three different radials, but does not describe these radials nor does it explain how they were chosen. The test results indicate huge variability between these radials, so this data would have been important to understand the testing that was performed.

Also missing are tests of commercial devices closer to the Progeny beacon. Since commercial devices have different use cases from consumer devices, this testing is crucial to understand how such devices would co-exist with the Progeny system.

5. **Improper Conclusions**. The Progeny test report presents a test campaign intended to demonstrate that Part 15 devices do not receive unacceptable levels of interference from the Progeny beacons. However, reviewing the test results for typical and atypical operation, it appears that the following is true:

   Under typical operations, one of twelve devices tested at thirteen different measurement locations received interference from the Progeny beacons. This indicates that 8.33% of the devices tested received interference under conditions consistent with their typical operation. Note that this device is not capable of switching to another channel and hence there is no way to practically reduce the interference from the Progeny system short of changing the design.

   Under "atypical" operations (where the Part 15 device is forced to share spectrum with the Progeny beacon), seven out of nine devices tested detected interference in an environment consistent with their typical operations. This corresponds with 77.8% of the devices tested.

   In the "break case" where the devices were tested under typical operations collocated with the Progeny beacon, five out of twelve devices detected the Progeny beacon. This is potentially due to overload at the receiver, which cannot be alleviated by clever interference mitigation techniques. This indicates that 41.7% of the tested devices receive interference from the Progeny beacons. Note that the atypical operation case was even worse.

   Assuming that, in the best case, the test results generalize to all 5216 devices in the EAS approved to operate in this band (which is not possible due to enormous categories of devices not being tested thoroughly, including commercial devices) there are hundreds of models of devices which would see unacceptable levels of interference from the Progeny system under typical operations. Under less general (but still reasonable) conditions, the number increases to the many thousands. It is clear that this test campaign indicates that the Progeny system *does* cause unacceptable interference to consumer commercial devices.
6. **Oversimplified Mitigation Strategies**. All of the test results of Class B devices in the Progeny report indicate that some devices detected interference from the Progeny beacons, which generally manifested itself as a hiss or click following the duty cycle of the beacon. The report suggests that a

mitigation strategy would be to move the transmitter and receiver closer together. However, this technique may not work for all consumers, and definitely would not work for some Class A commercial digital devices. As an example, a WISP device generally has one end point placed at an end user's home and another at the internet service provider. There is no practical way to move these devices closer together to mitigate interference from the Progeny system. As such, Progeny's system has the potential to knock out internet links that are currently working fine.

System Design

In this section we look at how the Progeny system differs from other Part 15 devices in the band.

1. **Progeny is not the same as a Part 15 device.** The Progeny system is a fixed broadcast network operating at high power, a constant duty cycle of 10% per base station and fixed frequency plan. The proposed system deployment would involve towers packed densely in urban environments to provide ubiquitous coverage indoors and out. This high power and dense deployment of transmitters has the potential to block Part 15 devices in the Progeny bands. As described by Progeny, the system uses two 2.046 MHz channels, one centered at 926.227 MHz and the other centered at 920.773 MHz. No Part 15 devices operating in the 902-928 MHz band operate with such high power, and most Part 15 devices do not occupy this much bandwidth.
2. **Almost Constant Interference**. The Progeny system is a multilateration system that requires measurements of three beacons to give position information. Much like a GPS system, the accuracy of the estimate improves as more beacons are detected. Progeny's test report has focused on interference from one beacon at a time. However, even with the 10 duty cycle that Progeny has voluntarily used in their system, since three or more beacons are required (with four or more desired) in the Progeny coverage area, the actual duty cycle on interference from the system could be as high as 80% or more foreight towers in site. . With the added potential for indoor beaconstakingup the remaining 20%. If Progeny were to embark on a full-scale deployment of their system, there are no rules preventing them from deploying in a very dense manner with a large number of beacons to improve the accuracy of the M-LMS system. This deployment scenario could be disastrous for devices which attempt to use spectrum near the Progeny channels.
3. **Dense Deployment**. As described in the Progeny Network Description, the allowed link loss for the Progeny system is 165 dB. Using standard Hata propagation models and assuming a 40m beacon height, 1.6m user, 928 MHz operation and 12 dB of building penetration, an urban deployment would have towers at most 6.59 km apart. This distance could be even closer if a higher building penetration number were used, or if the network operators desired more margin on their link. The primary use cases for M-LMS are for determining indoor locations, since GPS is very capable for outdoor use. However, many Part 15 devices are deployed out of doors and would see a huge amount of interference from such a dense deployment.

Testing Results – Itron Testing

Itron performed testing against the Progeny system. The results of this testing are detailed in a report filed with the FCC dated October 31, 2012.The report describes three classes of testing:

1. Tests with end points connecting directly to a receiver. All components are Part 15 devices.
2. Tests with end points connecting to a receiver through a repeater. All components are Part 15 devices.
3. Packet-error tests using a signal generator and actual receiver where interference from the Progeny system (and other 902-928 MHz devices) is injected into an actual Part 15 receiver.

Tests were performed with the Progeny system enabled and disabled. In the test report, the plots of test results are superimposed with received packets and success rates plotted as a function of frequency.The end point units tested by Itron transmits using a predefined frequency hopping channel plan with 100 channels; some of the channels in this band lie in the part of the 902-928 MHz spectrum used by Progeny. For the repeater tests, the repeater uses a 50 channel hopping plan with a larger number of channels in the Progeny spectrum. The test results indicate that the Itron system would see undesirable effects from the Progeny system on the Progeny channels. Tests were performed with the receiver at three locations:

- Close proximity, but not collocated, in a suburban environment.
- Close proximity and collocated, in an urban environment.
- No close proximity, in a suburban environment.

For the end-point to receiver tests performed at the first location, both the number of packets and the packet error rate tests indicated reduced receive performance in the Progeny bands. This test showed degraded performance at all mast heights, particularly at the 11 foot height. Charts of the decoded packet counts as a function of frequency were included in the test report. The chart on page 15, for example, shows that the channels co-frequency with the Progeny carriers received significantly fewer packets with the system on than they did with the system off. Other charts in this test location show similar behavior.

Another significant measure of system performance – the total packet success rate from the end-points to the receiver on the Progeny channels – was reduced for all mast heights. For the 11 foot mast height case that Itron identified as typical of the mobile end-point collection systems, the packet success rate dropped from 83.2% to 74.4%.

The packet error rate tests performed at the first location provide corroborating evidence that the Itron equipment was effected in the presence of the Progeny beacons on the channelsProgeny is operating in. Comparing the plots of Progeny on and Progeny off, the packet error rate tests show reduced performance in the Progeny spectrum and no reduction elsewhere in the band. The charts on pages 19, 20 and 21 show this clearly.

For the end-point to receiver tests performed at the second location, the amount of effect was less due to the less proximal location. However, the packet error rate tests clearly indicate the effect in the band Progeny is operating at all mast heights.

For the third test location, the Itron system demonstrated impairments at all mast heights when the Progeny system was on in the range they are operating on. This is to be expected due to the Progeny system's high power and high duty cycle relative to a Part 15 device. As with the tests at location 1, the Itron receiver received very few (or no) packets on channels in the Progeny band. The packet error rate tests also demonstrated impairments in the Progeny band. All plots of the decoded packet counts for this third test location demonstrated that the Progeny band was not usable at this location with the system enabled.

Also significant, the tests indicates that the packet success rate of the end-point units connecting to the cell-collector units was reduced from almost 84% to 71% for the 11 foot mast height.

The repeater tests also showed similar performance issues, as well as the PER tests clearly showing the Progeny beacons effects on the frequencies they are usingat the measurement locations.

WISPA Test Report

The test report provided by the Wireless Internet Service Provider Association (WISPA) dated October 31, 2012 also examined interference between Progeny and Part 15 devices, specifically Part 15 devices used for wireless, fixed-point-to-point internet service. The test plan examined two different models of wireless internet service devices (called Canopy and Ubiquiti). The system was configured such that one end point was placed in the mountains above San Jose, CA and contained a significant number of Progeny beacons within its beamwidth. The end point was located in San Jose, and in different locations for the Canopy and Ubiquiti tests. The tests were configured such that the second end point had no Progeny beacons in its beamwidth. For the Canopy system, the first location had the subscriber module (SM) and the second location had the access point (AP). For the Ubiquiti system, the roles were flipped, with the subscriber module in San Jose and the access point in the mountains.

For the Canopy system, three carriers were tested, one centered at 906 MHz (overlapping neither of the Progeny carriers), one centered at 920 MHz (centered near the lower Progeny carrier, receiving interference from both carriers) and one centered at 923 MHz (covering both Progeny carriers). For the 906 MHz carrier, the Progeny band had no effect on the internet link. However, for the 920 MHz and 923 MHz carriers, the Progeny system resulted in significant reductions in capacity.

For the 920 MHz case, the transmission rate from the AP to the SM, which would be expected to contain Progeny interference, was reduced by 15%. From the SM to the AP, which would not be expected to contain Progeny interference, was also reduced by 8%. For the 923 MHz case, the transmission rate was reduced by almost 50% for the AP to SM link and 13% for the SM to AP links. Due to the fast changes from Progeny on to Progeny off and the nature of the test setup, the only difference between these links was the amount of interference from Progeny beacons. It is clear that the throughput of the Canopy equipment was significantly affected by Progeny. This has significant repercussions for internet service providers who use WISP equipment.

The Ubiquiti system had similar results. The Ubiquity system supports only four carriers, two of which overlap significantly with the Progeny channels. The WISPA tests were run for three of the 10MHz carriers: One centered at 907 MHz (which does not overlap with Progeny at all), one centered at 917 MHz (which overlaps the lower Progeny carrier at the edge of the WISPA channel), and one centered at 922 MHz (which covers both Progeny bands).

The results of the WISPA field tests indicate that the Progeny system had a significant impact on the top two carriers. The 907 MHz channel had no reduced performance, but the 917 MHz channel had performance reduced by almost 50% when compared to the Progeny system being on. Even worse, the 917 MHz channel had this reduced performance on both sides of the link (from SM to AP and AP to SM) despite only the SM having the Progeny beacons directly in the beamwidth. The 922 MHz channel fared better, but the standard deviation of the throughput when Progeny was on was significantly higher. This may be due to some mechanism internal to the Ubiquiti system which is not explained in the test report.

In conclusion, the testing done by WISPA with the Progeny system shows significantly reduced transmission. For some standard configurations of the hardware, the throughput was reduced by half. This will significantly affect the end-user experience for users of WISP internal service and may drive customers to consider alternate options.

<u>Conclusion</u>

In conclusion, the test performed by Itron and WISPA indicate that the Progeny system causes significant and harmful interferenceto Part 15 devices that are on the shared channels for FHSS devices and on (or adjacent to) theshared channels for DSSS/DTS broadband devices, even in common consumer configurations. With many hundreds of millions of Part 15 devices deployed in this band, this would put providers of these devices in atough situation where some may have to provide mitigation to compensate for Progeny's effect on the band.In addition, the testing done by Progeny which was released in January is inadequate to demonstrate that the amount of interference is acceptable. The mitigation strategies they suggested may work for consumer, Class B devices where the transmitter and receiver can be moved together, but mitigating the interference for fixed devices would require fundamental changes in how the devices operate. In addition, the tests did not examine overload.

CERTIFICATION OF PERSONS RESPONSIBLE

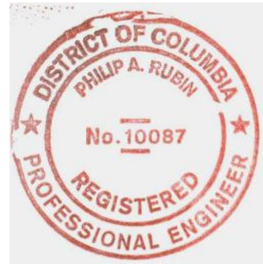
FOR PREPARING THE ENGINEERING INFORMATION

SUBMITTED IN THIS REPORT

I hereby certify that I am a technically qualified person responsible for the preparation of engineering information contained in this filing, that I am familiar with Part 15 of the Commission's rules, that I have prepared or reviewed the engineering information submitted in these reply comments, and that it is complete and accurate to the best of my knowledge. I am a registered Professional Engineer. My seal is attached.

By: ______________________

Philip A. Rubin, P.E. President
RKF Engineering, LLC
Washington, DC



I hereby certify that I am a technically qualified person responsible for the preparation of engineering information contained in this filing, that I am familiar with Part 15 of the Commission's rules, that I have prepared or reviewed the engineering information submitted in these reply comments, and that it is complete and accurate to the best of my knowledge.

By:___

Erik Halvorson
Member of the Technical Staff
RKF Engineering Solutions, LLC
Washington, DC

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